MAMMALIAN SPECIES No. 590, pp. 1–4, 4 figs.

Acomys russatus.

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Published 4 December 1998 by the American Society of Mammalogists

Acomys Geoffroy, 1838

Acomys Geoffroy, 1838:126. Type species *Mus cahirinus* Desmarest, 1819.

CONTEXT AND CONTENT. Order Rodentia, Suborder Sciurognathi, Family Muridae, Subfamily Murinae, Genus *Acomys*. The genus *Acomys* includes fourteen extant species (Wilson and Reeder, 1993).

Acomys russatus (Wagner, 1840)

Golden Spiny Mouse

Mus russatus Wagner, 1840:195. Type locality Sinai, Egypt.
Acomys russatus Wagner, 1840:195. Type locality Sinai, Egypt.

CONTEXT AND CONTENT. Context same as for genus. Four subspecies of *Acomys russatus* are recognized (Harrison, 1972):

Acomys russatus russatus Wagner, 1840:195. Type locality Sinai, Egypt.
Acomys russatus aegyptiacus Bonhote, 1912. Type locality Cairo, Egypt.
Acomys russatus lewisi Atallah, 1967. Type locality N.W. Azraq-Shishan, Syrian Desert, Jordan.
Acomys russatus harrisoni Harrison, 1972. Type locality Ein Faschka, Dead Sea area.

DIAGNOSIS. *Acomys russatus* is differentiated from other species within the genus by several characteristics, most notably its golden-yellow color (Fig. 1). A reddish to reddish-orange dorsal color and a tail (<80 mm long) shorter than the head and body are diagnostic. Buffy, white hairs overlay the ears, which have white basal and posterior patches (Osborn and Helmy, 1980). *A. russatus* has dentition similar to *Mus* except for the lack of cusp T7 and the outward projection of cusp T6. *A. russatus* is distinguished from *A. dimidiatus* by its more robust cheekteeth and lack of development of the small median posterior cusp on the heel of m1 and m2, seen when skulls of similar sizes are compared (Harrison, 1972).

The four extant subspecies of *A. russatus* differ from each other by easily identified physical characters. *A. r. lewisi* is the darkest subspecies of *A. russatus*, because the hair tips have less white, allowing for a grayish black coloration. *A. r. russatus* is redder or darker than either *A. r. harrisoni* or *A. r. aegyptiacus*. The latter is more yellowish and has brighter coloration than *A. r. russatus* (Bonhote, 1912; Harrison, 1972). The hind foot is slightly larger and the length of the tail is almost 20% longer in *A. r. russatus* than in *A. r. aegyptiacus*. The average diameter of the external auditory meatus in individuals of *A. r. russatus* is 12.6 mm compared with 12.4 mm in individuals of *A. r. aegyptiacus* (Setzer, 1959). A longer and narrower rostrum and smaller breadth across the zygomatic arches help distinguish *A. r. russatus* from *A. r. aegyptiacus* (Hoogstraal, 1963; Setzer, 1959). *A. r. harrisoni* is smaller with pale-colored pelage.

FIG. 1. Live adult *Acomys russatus* collected near Cairo, Egypt (Photograph courtesy of Dale J. Osborn.)

GENERAL CHARACTERS. *Acomys russatus* is a small to medium-sized, golden-yellow murid with pigmented, prominent ears that are smaller than the ears of *A. dimidiatus* (Harrison, 1972). Grayish bases of hair darken the whitish to yellowish sides and rump. Covering the back and tail are course, rigid spines (Nowak, 1991). All spines and dorsal hairs have a pale gray base, a yellowish to orange subterminal band, and a minuscule black tip (Osborn and Helmy, 1980). Spines from the mid-dorsal area in females obtained from Wadi Raman, Israel, were 13.1 mm long and 0.4 mm wide (Harrison, 1972). The spines from the mid-dorsal region are flattened dorsoventrally, with a longitudinal groove on the dorsal side. Spines extend ca. 2.2 mm above the distal region of the tail. The posterior back and rump have long white hairs extending beyond the spines up to 25 mm. Short spines cover the dorsal surface of the feet and are similar to the spines of the mid-dorsal region. Spines covering the hind feet are stiffer and more robust, measuring ca. 3.2 mm in length (Harrison, 1972). *A. russatus* has dark brownish-black claws with white tips. Ventral to each eye is a small white spot. White patches extend from behind the ears to the ear bases. On the sides of the neck and cheeks, a well defined line of demarcation is characteristic, but this line is not readily visible between the ventral and dorsal sides of the body (Harrison, 1972). The molar cusps show wear, the basioccipital-basisphenoid suture closes, and the cranial ridges become well-developed as the young develop into adults (Osborn and Helmy, 1980).

There is no sexual dimorphism in *A. russatus*. Mean (range in parentheses) for body and skull characters (in mm or g) of *A. r. russatus* and *A. r. aegyptiacus* (Osborn and Helmy, 1980): head and body length, 113.0 (106–122, $n = 15$), 109.2 (90–117, $n = 6$); tail length, 74.8 (68–81, $n = 8$), 64.4 (56–75, $n = 5$); hind foot length, 20.4 (20–22, $n = 16$), 19.2 (19–20, $n = 6$); ear length, 20.3 (19–22, $n = 16$), 19.3 (16–20, $n = 6$); occipitonasal length, 28.7 (27.6–31.1, $n = 11$), 29.2 (27.8–31.1, $n = 5$); greatest zygomatic width, 14.3 (13.9–14.8, $n = 14$), 14.4 (13.9–14.8, $n = 4$); least interorbital breadth, 4.5 (4.3–4.9, $n = 18$), 4.6 (4.4–4.9, $n = 5$); breadth of braincase, 13.1 (12.4–13.7, $n = 17$), 13.1 (12.4–13.6, $n = 4$); nasal length, 11.2 (10.0–12.0, $n = 6.9$), 11.5 (11.0–12.0, $n = 5$); greatest length of the right incisive foramen, 6.9 (6.4–7.4, $n = 18$), 6.9 (6.6–7.4, $n = 4$); alveolar length of upper tooth row, 5.0 (4.8–5.2, $n = 18$), 5.2 (5.0–5.2, $n = 5$); and skull height, 10.4 (9.9–10.9, $n = 16$), 10.4 (9.9–10.9, $n = 4$). Mass for *A. r. aegyptiacus* only is 37.0 g (24.0–53.2, $n = 3$). Other scientists also have recorded average measurements of *A. russatus* (Atallah, 1967; Bonhote, 1912; Harrison, 1972; Haim and Borut, 1975; Morrison-Scott, 1939; Setzer, 1959; Shafrir and Adler, 1983; Wassif and Hoogstraal, 1953). Adult specimens of *A. russatus* raised in captivity were found to have an average weight of 42.5 g (Bonhote, 1912). An average weight of 51.5 g was observed by Shkolnik (1966) in 83 specimens of Israeli mice. In December specimens from Mount Sinai vicinity averaged 67.2 g, whereas members of this same population averaged 52 g in March (Haim and Borut, 1975). Haim and Borut (1975) reported an average weight of non-pregnant females of 75.4 g in September and 55.4 g in February. Pregnant females have an elevated weight (Haim and Borut, 1975). Geographic distribution and weight also have been studied by several others (Atallah, 1967; Bonhote, 1912; Haim and Borut, 1975;

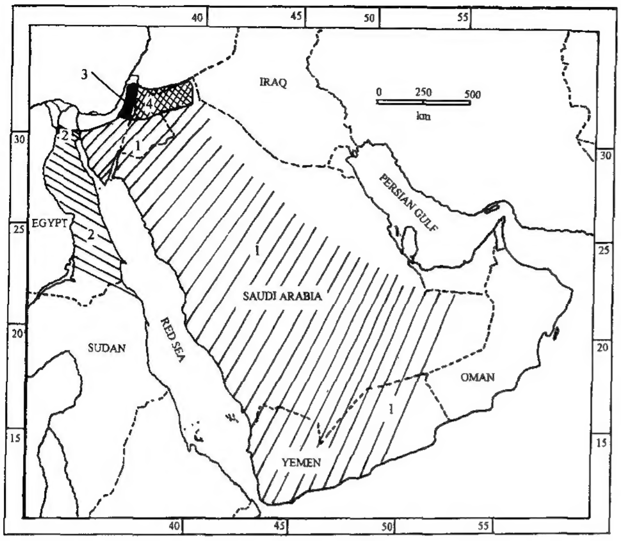

FIG. 2. Geographic distribution of *Acomys russatus.* 1, *A. r. russatus*; 2, *A. r. aegyptiacus*; 3, *A. r. harrisoni*; and 4, *A. r. lewisi.*

Harrison, 1972; Hoogstraal, 1963; Setzer, 1959; Wassif and Hoogstraal, 1953).

DISTRIBUTION. Members of the genus *Acomys* are found across much of Africa and southwestern to southcentral Asia as far east as the Indus River (Corbet, 1978). *Acomys russatus* is located along the borders of the great Syrio-African Rift Valley: South Yeman, Saudi Arabia, Egypt (east of the Nile), southern Sinai, the section of the Rift Valley found in the central and southern portions of Israel, and near the Dead Sea in Jordan (Fig. 2). Specimens have been taken in environments where cold temperatures persist during the winter, such as the summits of mountains found in Southern Sinai which are covered with snow annually (Atallah, 1967; Haim and Borut, 1981; Harrison, 1972). *A. r. russatus* is found in the southern portion of the Sinai peninsula, Saudi Arabia, (former) South Yemen, Israel, and Jordan. *A. r. russatus* also inhabits South Palestine (Flower, 1932). *A. r. aegyptiacus* is located in the northern portion of the Eastern Desert in Egypt from the North Galala mountain range near the Red Sea to Wadi Hof (Harrison, 1972; Hoogstraal, 1963; Osborn and Helmy, 1980). *A. r. lewisi* is found in the Syrian Desert near Azraq-Druz and Azraq-Shishan in Jordan. *A. r. harrisoni* inhabits Ein-Faschka northwest of the Dead Sea (Harrison, 1972). Golden spiny mice are found often in rocky habitats coinhabited by *A. cahirinus.* Elevational range is sea level to 2,642 m (Haim and Borut, 1975).

FORM AND FUNCTION. The tail is brittle, easily autotomizing. Tail length is not indicative of age (Nowak, 1991; Wassif and Hoogstraal, 1953). *Acomys* has four or six mammae (Nowak, 1991). The braincase of the skull is broad (Osborn and Helmy, 1980). The interparietals are large and semicircular; supraorbital and parietal ridges are well-developed and curve outward. The apex of the mesopterygoid shelf is anterior to the level of the basisphenoid-presphenoid suture. The palate is lacking a median keel (Osborn and Helmy, 1980). The median occipital crest composes the furthest point of the skull posteriorly (Fig. 3). *A. russatus* has a relatively long rostrum, a long jugal, and anteriorly wide zygoma. The zygomatic arches are expanded more dorsoventrally than in *A. dimidiatus.* The mesopterygoid fossa anteriorly is sheltered by bone, whereas a median horizontal ridge is formed from the connecting of plate-like outgrowths from the palatines. There is fusion between the hamular processes and the tympanic bullae (Fig. 3). The tympanic bullae vary in size. Compared with *A. dimidiatus,* the mandible in *A. russatus* is smaller yet similar in form except for the coronoid process where a greater depth is visible (Harrison, 1972; Osborn and Helmy, 1980). Atallah (1967) describes a completely ossified trifid where the baculum terminates (Fig. 4).

The dental formula is i 1/1, c 0/0, pm 0/0, m 3/3, total 16 (Harrison, 1972). Long incisive foramina extend past the medial root of M1. The I1 is opisthodont and compressed with normal edges and a smooth anterior surface. The first lamina of the three-

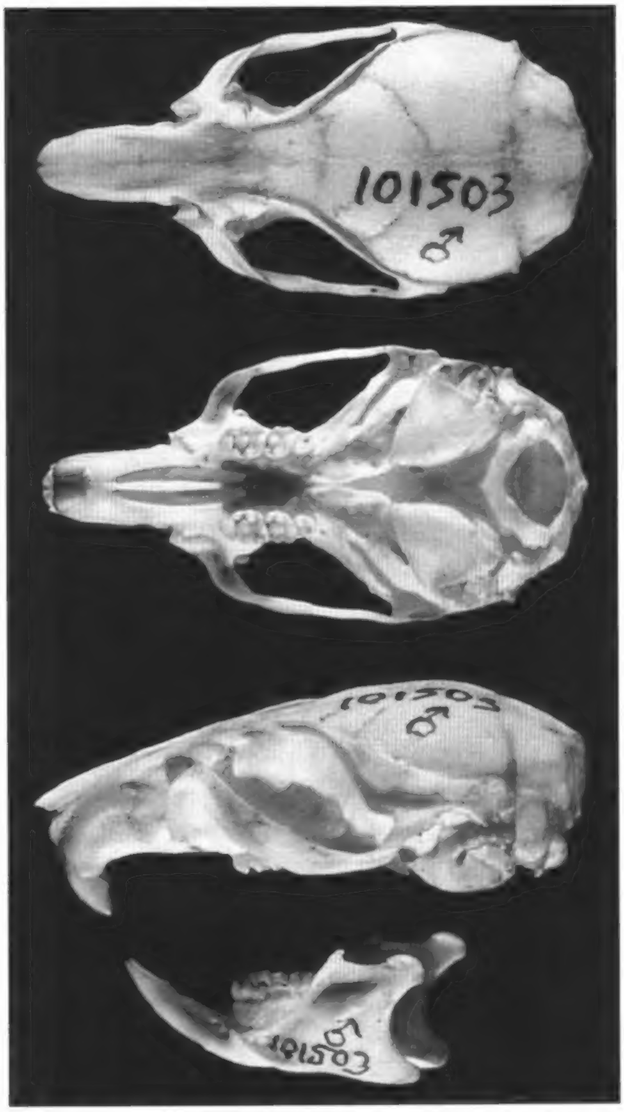

FIG. 3. Dorsal, ventral, and lateral views of cranium and lateral view of mandible of male *Acomys russatus* from Wadi Qiseib, Sez, Egypt (FMNH 101503). Greatest length of skull is 28.1 mm. (Specimen courtesy of Lawrence Heaney, Field Museum of Natural History, FMNH).

rooted M1 is directed backwards. M1 is lacking T7. The second lamina of M2 has three cusps, whereas T8 and T9 are present in the posterior lamina. There are two lamina in M3 (Harrison, 1972; Osborn and Helmy, 1980).

Haim and Borut (1981) found that different populations of *A. russatus* have become better adapted to colder environments, presumably because of differences in heat production. Mice were obtained from cold habitats in the mountains of South Sinai, and hot environments in the vicinity of the Dead Sea at Ein-Gedi. When exposed to ambient temperatures of 6°C, Ein Gedi mice could not maintain body temperature and they became hypothermic, whereas South Sinai mice were able to maintain their body temperature. When exposed to an ambient temperature of 28°C, both groups of

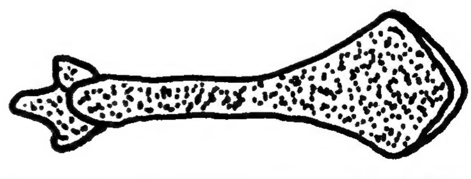

FIG. 4. Baculum of *Acomys russatus* (modified from Atallah, 1967).

mice were able to acclimate to the hot environment. Both groups of mice had identical resting O_2 consumption in the heat. Below 20°C, body temperature dropped in Ein Gedi mice. The ability of *A. russatus* to survive in colder environments most likely results from better heat production. It was previously thought that higher nonshivering thermogenesis, was responsible for the survival of South Sinai mice in colder habitats (Haim and Borut, 1976). Reduced thyroid activity and shivering thermogenesis observed in Ein Gedi mice, suggests that increased nonshivering thermogenesis is an adaptation in South Sinai mice. Shkolnik and Borut (1969) describe *A. russatus* as having survived ambient temperatures up to 42.5°C, but ambient temperatures over 40°C were fatal to *A. cahirinus*. This indicates that *A. russatus* is better adapted for diurnal activity in hot environments.

ECOLOGY. Unlike most other rodents, *A. russatus* is fully exposed to the harsh desert environment because of its diurnal activity; however, temperatures exceeding 30–33°C are avoided. *A. russatus* appears to avoid *A. cahirinus*, as *A. russatus* becomes active when *A. cahirinus* ceases activity, and vice versa. Israeli specimens (Ein-Gedi) of *A. russatus* were not able to survive ambient temperatures <18°C, whereas members of *A. russatus* were observed in Southern Sinai throughout the year on mountain tops where much lower temperatures occur (Shkolnik, 1966, 1971; Shkolnik and Borut, 1969) .

Haim and Borut (1975) studied size and activity in cold resistant mice (Sinai mice). Cold resistant mice weighed more than cold sensitive mice. This probably is a result of extra fat stored for the winter as an energy reserve. Body weight of Sinai mice changed according to the seasons, decreasing body weight at the end of the cold season and increasing it before the weather becomes cold. The cold environment of Sinai mice does not result in a higher morality rate than other species within the genus *Acomys* (Haim and Borut, 1975).

Acomys russatus cannot survive on a diet with little water because of its high evaporation rate from the skin (Shkolnik and Borut, 1969). *A. russatus* is better adapted than *A. cahirinus* to obtain water from sap found in desert plants. These plants have high electrolyte contents. Concentrated electrolyte solutions can be excreted by *A. russatus*. Shkolnik and Borut (1969) illustrated this characteristic by forcing specimens of *A. russatus* to drink NaCl and water solutions of 0.7–0.9 M. Specimens of *A. russatus* are omnivorous, but primarily ingest plants (Nowak, 1991).

Acomys russatus can produce a concentrated urine with almost twice the maximum chloride concentration of *A. cahirinus* urine, enabling *A. russatus* to better obtain water from salty plants. Maximum urea concentrations in the urine of spiny mice are some of the highest recorded for mammals. The ability of the kidneys to concentrate urea allows *A. russatus* to eat salty plants and land snails. *A. russatus* can even survive drinking sea water (Harrison 1972; Shkolnik and Borut, 1969). Aspects of the diabetes prone *A. russatus* were examined by Shafrir and Adler (1983). When removed from the desert habitat and put on a regular or fat-rich seed diet, *A. russatus* had a significant weight gain. Specimens on these diets received more food than normal, which caused an increase in metabolism. This tended to cause diabetes. Specimens removed from the natural desert environment became obese when placed on a diet that produced ketonuria. These data support statements that *A. russatus* can store and utilize fats well, which leads to good glucose homeostasis. However, large amounts of excess fats result in the malfunction of metabolic control as ketosis occurs. It appears that the desert environment results in deficient pancreatic function as well as a reduction of glucose tolerance (Shafrir and Adler, 1983). *A. russatus* seldom or never enters buildings (Hoogstraal, 1963; Wassif and Hoogstraal, 1954).

REPRODUCTION AND ONTOGENY. Little is known about reproduction in *A. russatus*, but there are several general characteristics of reproduction among the genus *Acomys*. Umbilical cords are bitten by females who have previously given birth. New mothers also are cleaned by their own mothers. Reproduction is perennial, and it may not cease even after the birth of more than twelve litters. The length of gestation is usually 4–5 weeks. Older mothers typically give birth to larger litters, with litters ranging in size from 1 to 5. At birth the young are well developed, weigh up to 7 g, and can see at birth or within a few days of birth. After 2–3 months the young attain sexual maturity. *Acomys* average a 3-year life span, but some specimens live up to 5 years (Nowak, 1991). Reproduction is believed to be continual under favorable conditions (Kingdon, 1974).

GENETICS. *Acomys russatus* has a karyotype of 2n = 66, FN = 76, which is significantly different from that of *A. percivali*, with 2n = 36, FN = 68 (Wahrman and Zahavi, 1953). The karyotype of *A. russatus* and *A. lewisi* were found to be indistinguishable from one another by Qumsiyeh et al. (1986), supporting the idea that *A. lewisi* may be a subspecies of *A. russatus*. The karyotype of *A. subspinosus* is similar to that of *A. russatus* (Janecek et al., 1991). A study by Janecek et al. (1991) provided electrophoretic data that suggest *A. subspinosus* and *A. russatus* are the most closely related taxa of *Acomys* in northern Africa.

REMARKS. The generic name *Acomys* is derived from *aco*, from the Greek prefix *acro*, point, similar to the Greek *akanthos*, a thorn or spine, thus referring to the spines these mice bear. In Latin *russatus* means clothed in red.

We thank the Natural Science Division and B. Hutchinson at Pepperdine University and the Biology Department at Abilene Christian University for supporting the project. We also appreciate the assistance of L. Janecek, L. R. Heaney, and D. Osborn in obtaining figures and photographs. G. Tallman and M. Thornton reviewed an earlier version of the manuscript.

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